
Overview of Two Projects to Improve Emissions Monitoring Efficiency

John Schakenbach, USEPA
Art Werner, Gene Fax, Scott Shanklin, Cadmus Group

Electric Power Research Institute
CEM Users Group Meeting
Charlotte, NC
May 16, 2001



Improving Efficiency

- ◆ Efficiency: “effective operation as measured by a comparison of production with cost (as in energy, time, and money)” *Webster*



Two Projects Potentially Improving Efficiency

- ◆ Predictive Emissions Monitoring (PEMS)
- ◆ Independent 3rd party quality assurer



PEMS Study Goals

- ◆ Compare NO_x PEMS to CEMS over adequate range of operating & ambient conditions, and sufficient time period
- ◆ Perform field test at representative combustion turbine
- ◆ Determine classes of combustion turbines to which PEMS may be applicable
- ◆ Determine appropriate PEMS inputs
- ◆ Determine appropriate QA/QC tests, and any other necessary qualifications



What's a PEMS?

- ◆ Predictive Emissions Monitoring System
- ◆ A set of mathematical models that develops a numerical relationship between a unit's operating parameters and a pollutant
- ◆ Does not directly measure emissions



Study Timeline

FY 2000	FY 2001	FY2002	FY2003
Inventories Projections Assessment Costs Test Plan	Peer review Field test Data report	Analysis Peer review Findings Rulemaking	Rulemaking



Types of PEMS

- ◆ First Principles use equations to calculate NO_x emissions from turbine operating and ambient air parameters, material balances, thermodynamics and reaction kinetics.



Types of PEMS

- ◆ Neural Network attempts to predict future behavior by developing a profile of past behavior; makes no assumptions about underlying causes; multiplies inputs such as ambient temperature and humidity, fuel flow, exhaust gas temperature, power output, compressor discharge temperature and pressure, and water/fuel ratio by weighting factors, and sums and transforms inputs using transfer functions to predict NO_x emissions.



Types of PEMS

- ◆ Regression establishes relationship between NOx emissions and turbine operating characteristics.



Potential Market

- ◆ NOx PEMS most likely for existing App. E peaking units transitioning to baseload operation
- ◆ NOx PEMS installations are not suitable for units with post-combustion NOx controls.

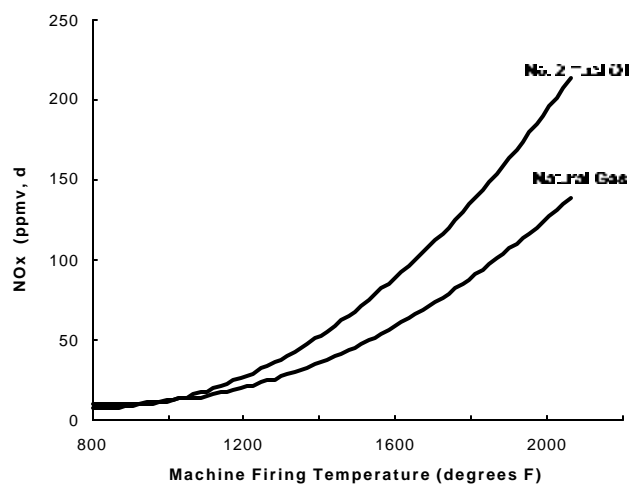


Preliminary PEMS Findings

- ◆ Humidity, and compressor discharge temperature and pressure are most commonly selected as influencing CT NO_x formation
- ◆ Combustion turbine performance degradation from fouling and erosion over time may be problematic for PEMS unless heat rate measurements are included as a model input



NO_x Emissions vs Turbine Firing Temp

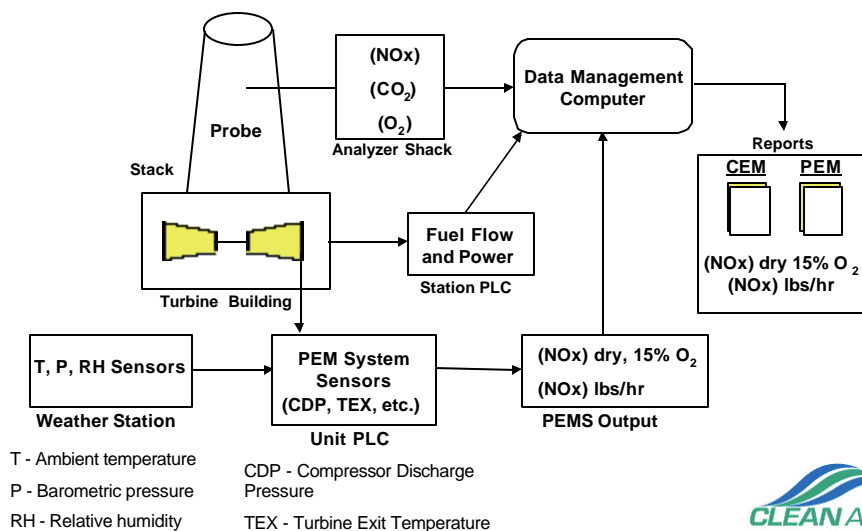


Field Test

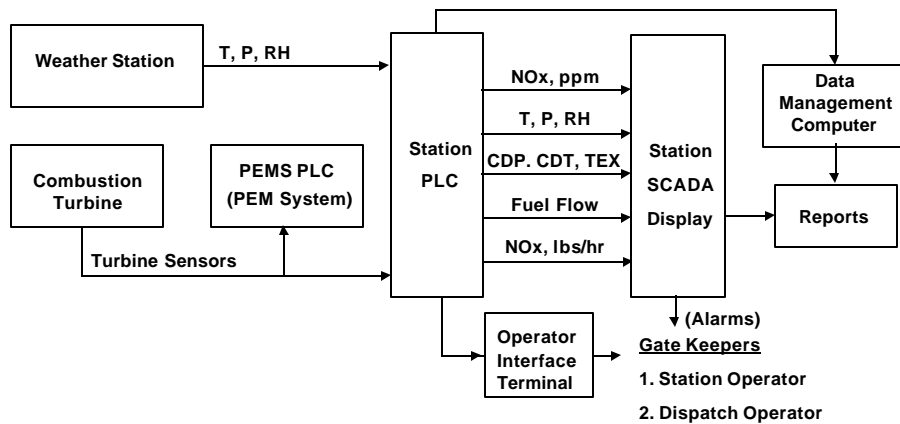
- ◆ Host site is _____
- ◆ 6-7 month duration to capture summer, fall, winter ambient temperature and humidity variations
- ◆ 3 - 6 PEMS will be compared to Part 75-certified NO_x CEMs
- ◆ Quarterly RATAs
- ◆ Test sensor failure
- ◆ Determine appropriate QA/QC



PEMS Field Test Block Diagram



PEMS Implementation Block Diagram



Improving Efficiency

- ◆ Efficiency: “effective operation as measured by a comparison of production with cost (as in energy, time, and money)” *Webster*



What is an Independent 3rd Party Quality Assurer?

- ◆ Qualified organization providing assurance of high quality products or services
- ◆ Could be governmental or non-governmental organization
- ◆ Examples:
 - Underwriter's Laboratory certifying products;
 - National Sanitation Foundation performing drinking water QA/QC



How Could 3rd Party Help?

- ◆ Move toward stack tester accreditation
- ◆ Audits of calibration gases
- ◆ Audits of wind tunnels
- ◆ Develop tolerances, e.g., how much drift are CEM components subject to?
- ◆ Other?



Continuum of Stack Tester Accreditation

**Test method exists;
buyer beware**

**Rigid accreditation
of all stack testers**



Why Establish 3rd Party?

- ◆ Mistakes = \$
- ◆ After the fact mistakes = Lots more \$
- ◆ Potential to streamline requirements
- ◆ Stability



Benefits for Sources & Vendors

- ◆ Calibration gases are more accurate
- ◆ Wind tunnels more accurately calibrate probes used to calibrate flow monitors
- ◆ Stack testers perform more effectively
- ◆ Vendors get products QA'd faster
- ◆ More certainty of recertification requirements



Stability

- ◆ Self-supporting 3rd party not subject to yearly budget variations and funding priorities
- ◆ Consistent procedures used year-to-year



Let Us Hear From You

- ◆ What activities are good candidates?
- ◆ How to ensure voice in standards development for all parties?
- ◆ Could certain activities be revenue-producing?
- ◆ Seeking to establish exploratory development group

